State Goals Overview

Outline

- Background
- State Goals
- State Flexibility
- Examples
- On-the-way Reductions
- Walk Through of State Goal Derivation

State Goals - Calculation

$$\frac{\text{State } CO_2 \text{ emissions from covered fossil fuel fired power plants (lbs)}}{\text{State electricity generation from covered fossil plants + RE + nuclear}_{ar\&UC} + \text{EE (MWh)}}$$

Basic formula for state goal

- The numerator is the sum of CO_2 emissions at covered fossil fuel fired power plants in that state .
- The denominator is electricity generation in the state, factoring in megawatt hours from fossil fuel power plants plus other types of power generation like renewables and nuclear, as well as megawatt hour savings from energy efficiency in the state.
  - More specifically -- this includes covered fossil sources, existing and new renewable energy (but excluding existing hydro), 6% of the nuclear fleet's generation, and EE accounted for as zero emitting MWh.
- No single fossil fired unit has to meet any of these goals.

State Goals – What is BSER?

- State goals do not lay out a set of required mechanisms a state must use to reduce carbon pollution. They are a numeric target that a state must plan to meet through the measures they choose.
- EPA is setting state goals after determining the Best System of Emission Reduction (BSER).
- Because the power sector is interconnected, EPA determined that a set of 4 measures together are the best system to reduce carbon pollution from fossil fuel fired power plants.
- The best system is made up of 4 building blocks that are being implemented now and can be implemented more broadly across the power system :

  (1) measures to make coal plants more efficient,

  (2) increased use of high efficiency, natural gas combined cycle plants,

  (3) generating electricity from low/zero emitting facilities, and

  (4) demand-side energy efficiency.

State Goals – Why They Are Different?

- State goals are unique to each state factoring in the amount of reductions that can be achieved through the 4 building blocks:
- Key factors that influence an individual state goal include:
    - The ratio of coal to existing natural gas combined cycle units
    - Magnitude of state RPS's within region
    - Energy demand (which impacts the potential for reductions from energy efficiency)
  - Because the key factors that influence individual state goals are different for every state, each state's goal (and reduction percentage) is different.
- The percentage reduction in emission rate implied by the 2012 actual rate (adjusted for RE) and the targets in other years is not the same as a required percentage reduction in mass emissions.
  - This can be easily seen because increases in EE and RE can be accompanied by varying decreases in emissions.
  - Overall, the 2012 rate to 2030 State goal comparison suggest a 33% reduction between the adjusted emission rate and the state goals, but this is achieved via a 17% reduction in emissions over that same time period.

- EPA is not proposing emission rate goals or guidelines for sources in Indian country and U.S. territories at this time. However, EPA will be proposing goals "if necessary or appropriate" for areas of Indian country with affected power plants and for U.S. territories with affected power plants in a supplemental proposal.

State Flexibility – States Get to Decide

- State goals are unique to every state because they reflect the diversity of how states produce and consume electricity.
  - For example, some states have more coal-fired generators and therefore more potential for heat rate improvements.
- State goals do not define or limit states compliance choices
  - States can choose to meet their goal using more or less of any of the compliance options in the four building blocks.
  - They can also use compliance options not included in the building blocks such as new NGCC, transmission improvements and retrofit CCS.
- State goals were not derived using any 2005 data
  - EPA described the overall, nationwide reduction target in reference to 2005, because that is a common year to consider when evaluating GHG emission reductions

State Goals – Learning More

- EPA's analysis shows how each state goal was calculated and walks the reader through a detailed example.
  - Remember: EPA calculated the goal based on the specific actions EPA has defined as BSER under the Clean Air Act– not on a particular compliance approach.
  - **The proposal provides significant flexibility for states to achieve reduction in any number of ways, therefore state goals are not prescriptions for any specific actions in any state.**
  - Each state has substantial flexibility to determine how to meet its goal.
    - A state can employ all, some, or none of the strategies EPA used to calculate the goal in its state plan as long as the state can demonstrate how the plan's actions will get them to its goal and achieve real reductions in carbon pollution from power plants.
- Let's take a look at a couple of examples of State Goals

Example 1 – Central State

"Central State" has a fossil intensive energy mix consisting primarily of coal and natural gas power plants sources which together generate approximately 114 TWh of electricity. It has no nuclear generation.

1. Central State's starting 2012 emission rate is 1,924 lbs/MWh.
2. EPA applies Block 1 (reduced CO_2 emissions 6% due to heat rate improvements at Central State's coal fleet on average)
3. EPA applies Block 2 (redispatching generation away from coal and oil/gas steam sources and toward the state's NGCC fleet, running them more)
4. EPA applies Block 3 (rate goes down as generation from zero and low-emitting renewable sources increases – only a small drop because Central State does not have any nuclear power)
5. EPA applies Block 4 (rate goes down as efficiency programs take hold and Central State's residents and businesses use less power to do more work)
6. Central State's final goal is 1,531 lbs/MWh, a 20% reduction from their 2012 emission rate.

Central State is already on its way to meeting this goal through a series of programs including energy efficiency codes for residential buildings and commercial buildings and renewable energy portfolio goals.

Calculating Central State's Goal

Starting rate	1,924
After Block 1	1,817
After Block 2	1,772
After Block 3	1,707
After Block 4	1,531
Final Goal	**1,531**

Example 2 – Western State

"Western State" has a more narrow energy mix consisting of one coal-fired power plant, 10 NGCC plants, and an abundance of hydro generation (80%) which together generate a similar amount of electricity as Central State.

1. Western State's starting 2012 emission rate is 756 lbs/MWh. (lower than Central State's starting rate because more of Western State's power comes from lower carbon emitting sources)
2. EPA applies Block 1 (small amount of reduced CO_2 emissions due to potential heat rate improvements at Western State's one coal plant)
3. EPA applies Block 2 (reflects a large drop in rate, due to complete redispatch from the one coal source (scheduled to retire) to existing NGCC. However, because of the limited fossil fleet and generation totals involved, the on-the ground impact is minimal)
4. EPA applies Block 3 (rate goes down as generation from zero and low-emitting renewable sources increases)
5. EPA applies Block 4 (rate goes down as efficiency programs take hold and Western State's residents and businesses use less power to do more work)
6. Western State's final goal is 215 lbs/MWh, a 72% reduction from their 2012 emission rate.

Calculating Western State's Goal

Starting rate	756
After Block 1	728
After Block 2	444
After Block 3	298
After Block 4	215
Final Goal	**215**

While the rate change may look more significant than Central State's, it does not necessarily entail more reduction measures, but is rather a reflection of the low fossil generation in Western State.

In fact, Western State is already well on its way to meeting this goal through a series of programs including greenhouse gas performance standards, energy efficiency standards, demand-side energy efficiency programs that advance energy efficiency improvements for electricity use, energy efficiency codes for residential and commercial buildings, appliance and equipment efficiency standards, and renewable energy portfolio standards.

Unique Fleets = Unique Emission Rates

- In this example, Central State and Western State have very different power fleets
  - In 2012, Central State produced 97% of its power from fossil fuels, while Western State produced 9% of its power from fossil fuels
- Because Western State has relatively less fossil fuel-fired generation, a given action to reduce its CO_2 emissions will have a greater impact on its CO_2 emission rate than the same action would have in a state like Central State with relatively more fossil fuel-fired generation
  - For example, increasing renewable generation by 2 terawatt-hours can reduce Western State's emission rate by 10% but would only reduce Central State's emission rate by 2%
- Each state's goal reflects its ability to improve its CO_2 emission rate, taking its unique circumstances into account
  - Therefore, Western State's "lower" state goal doesn't mean that this rule would ask Western State to "do more," in part because its emission rate is more sensitive to a given action to reduce CO_2.

On-the-way Reductions

- Southern State's adjusted rate for 2012 is 1,650 lb/MWh (reflecting existing "at risk" nuclear and RE), BSER is applied to determine state goal of ~1,100 lb/MWh

- However, Southern State has already initiated measures to make significant progress towards the state goal*:
  - Realization of Southern State's RPS will bring the rate down to ~1,462 lb/MWh
  - The 2,250 MW of under construction NGCC will bring the rate down to ~1,389 lb/MWh
  - Coal retirements in 2013 led to a drop from 50 TWh to 46 TWh, bringing the rate down to ~1,354 lb/MWh

* Rate changes are preliminary estimates and shown here for illustrative purposes. Actual rate will ultimately depend on the generation values for the state in a given year.

What Next?

1) Review the inventory of "likely covered units"
2) Review the 2012 emissions and generation data for these units
3) Estimate the 2030 emissions and generation data for these units
4) Estimate the RE MWh and EE MWh achieved by 2030
5) Estimate ability to comply with 2030 state goal by plugging values from #3 and #4 into the equation on slide 1 or the full equation below.

$$\text{State Goal}^* = \frac{\text{(coal gen. x coal emission rate) + (OG gen. x OG emission rate) + (NGCC gen. x NGCC emission rate) + "Other" emissions}}{\text{Coal gen. + OG gen. + NGCC gen. + "Other" gen. + Nuclear gen.}_{uc+ar} + \text{RE gen. + EE gen.}}$$

* Relevant data for state goal calculation can be found in Appendix 1 of the Goal Computation TSD and tables 4-1 (existing renewable energy) and 4-10 (nuclear) in the GHG Abatement Measures TSD

Appendix - Example of State Goal Derivation

The following example shows the derivation for the Ohio's State Goal.

- Additional explanation and discussion can be found in the goal computations Technical Support Document at http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-goal-computation
- The underlying data and calculations for all states can be found in Appendix 1 at http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-technical-documents
- The underlying plant-level data and unit-level inventory can be found in Appendix 7 at http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-technical-documents

- Discussion of the Building Blocks and corresponding state level assumptions for each can be found in the GHG Abatement Measures TSD at http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-ghg-abatement-measures

Step 1 – Calculation of 2012 fossil emission rate (Ohio)

$$\frac{\text{(Coal gen. x coal emission rate) + (OG gen. x OG emission rate) + (NGCC gen. x NGCC emission rate) + "Other" emissions}}{\text{Coal gen. + OG gen. + NGCC gen. + "Other" gen.}}$$

$$\frac{(86{,}473{,}075 \times 2{,}126) + (321{,}602. \times 1{,}332) + (20{,}907{,}183 \times 963) + 284{,}732{,}506}{86{,}473{,}075 + 321{,}602 + 20{,}907{,}183 + 214{,}178}$$

Rate – 1,897 lbs/MWh

Where can I find this data?

Appendix 1 of the Goal Computations TSD at http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-technical-documents

	2012 Rate (lbs/MWh)			2012 mass (lbs)	2012 Generation (MWh)				2012 Capacity
	A	B	C	D	E	F	G	H	I
	Coal Rate	OG Steam Rate	NGCC Rate	Other Emissions	Coal Gen	OG Steam Gen	NGCC Gen	Other Gen	NGCC MW
Ohio	2,126	1,332	963	284,732,506	86,473,075	321,602	20,907,183	214,178	4,343

Step 2 – Apply BB1 (6 % HRI)

$$\frac{\text{(Coal gen. } \mathbf{x \text{ coal emission rate}}\text{) + (OG gen. x OG emission rate) + (NGCC gen. x NGCC emission rate) + "Other" emissions}}{\text{Coal gen. + OG gen. + NGCC gen. + "Other" gen.}}$$

$$\frac{\text{(86,473,075 x } \mathbf{1{,}999}\text{) + (321,602. x 1,332) + (20,907,183 x 963) + 284,732,506}}{\text{86,473,075 + 321,602 + 20,907,183 + 214,178}}$$

Rate – 1,795 lbs/MWh

Where can I find this data?

Appendix 1 of the Goal Computations TSD at http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-technical-documents

	Emission Rate (lbs/MWh)			Emissions (lbs)	Generation (MWh)				2012 Capacity
	A	B	C	D	E	F	G	H	I
	Coal Rate	OG Steam Rate	NGCC Rate	Other Emissions	Coal Gen	OG Steam Gen	NGCC Gen	Other Gen	NGCC MW
Ohio	1,999	1,332	963	284,732,506	86,473,075	321,602	20,907,183	214,178	4,343

Step 3a – Apply BB2 (70% NGCC Redispatch Ceiling)

(**Coal gen**. x coal emission rate) + (**OG gen**. x OG emission rate) + (**NGCC gen**. x NGCC emission rate) + "Other" emissions
Coal gen. + **OG gen.** + **NGCC gen**. + "Other" gen.

(80,700,563 x 1,999) + (**300,133** x 1,332) + (**26,701,164** x 963) + 284,732,506
80,700,563 + 300,133 + 26,701,164 + 214,178

	Pre Redispatch (TWh)	Post Redispatch (TWh)
Coal	86.5	80.7
OG Steam	.321	.300
NGCC	20.9	26.7
Total	107.7	107.7

State's NGCC fleet at 70% CF

Rate – 1,739 lb/MWh

Step 3b – Apply BB2 for Under Construction NGCC

(**Coal gen**. x coal emission rate) + (**OG gen.** x OG emission rate) + (**NGCC gen**. x NGCC emission rate) + "**Other"** emissions

Coal gen. + OG gen. + NGCC gen. + "Other" gen.

(79,993,008 x 1,999) + (**297,502** x 1,332) + (**27,411,350** x 963) + **2,791,474,08**4

79,993,008 + 297,502 + 27,411,350 + **2,818,194**

	Pre Redispatch (TWh)	Post Redispatch (TWh)
Coal	86.5	80.0
OG Steam	.321	.297
NGCC	20.9	27.4
Total	107.7	107.7

4,343 MW x 8784 hours x 70% CF = 26,701,164
539 x 8784 x 15% CF = 710,186
Total NGCC = 27,411,350
539 x 8784 x 55% CF =2,604,017
Total "other"= 2,604,017 + 214,178 = 2,818,195

Rate – 1,715 lb/MWh

Step 4a – Apply BB3 (nuclear)

(Coal gen. x coal emission rate) + (OG gen. x OG emission rate) + (NGCC gen. x NGCC emission rate) + "Other" emissions
Coal gen. + OG gen. + NGCC gen. + "Other" gen. + **Nuclear gen.**$_{AR + UC}$

(79,993,008 x 1,999) + (297,502 x 1,332) + (27,411,350 x 963) + 2,791,474,084
79,993,008 + 297,502 + 27,411,350 + 2,818,194 + **993,077**

Rate – 1,699 lbs/MWh

Ohio Nuclear Capacity	2,150 MW
"At Risk" Capacity (2,150 x 5.8%)	126 MW
"At Risk Generation (x .90% * 8784h)	993,077 MWh

Where can I find this data?

Appendix 1 of the Goal Computations TSD at http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-technical-documents
and
Chapter 4 of the GHG Abatement Measures TSD discusses the derivation of the "at risk" nuclear. Table 4-10 of the GHG Abatement Measures TSD at http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-ghg-abatement-measures

Step 4b – Apply BB3 (RE Gen)

$$\frac{\text{(Coal gen. x coal emission rate) + (OG gen. x OG emission rate) + (NGCC gen. x NGCC emission rate) + "Other" emissions}}{\text{Coal gen. + OG gen. + NGCC gen. + "Other" gen. + Nuclear gen.}_{AR+UC} \textbf{ + RE gen.}}$$

$$\frac{(79{,}993{,}008 \times 1{,}999) + (297{,}502 \times 1{,}332) + (27{,}411{,}350 \times 963) + 2{,}791{,}474{,}084}{79{,}993{,}008 + 297{,}502 + 27{,}411{,}350 + 2{,}818{,}194 + 993{,}077 + \textbf{13{,}775{,}594}}$$

Rate – 1,512 lbs/MWh

	RE Gen.
Existing as of 2012	1,738,622 MWh
Amount assumed in goal for 2030	13,775,594 MWh

Where can I find this data?

Appendix 1 of the Goal Computations TSD at http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-technical-documents and
Chapter 4 of the GHG Abatement Measures TSD Discusses the Derivation of the RE MWh for each state. Table 4-1 of the GHG Abatement Measures TSD at http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-ghg-abatement-measures

Step 5 – Apply BB4 (MWh of EE)

$$\frac{\text{(Coal gen. x coal emission rate) + (OG gen. x OG emission rate) + (NGCC gen. x NGCC emission rate) + "Other" emissions}}{\text{Coal gen. + OG gen. + NGCC gen. + "Other" gen. + Nuclear gen.}_{AR+UC} + \text{RE gen. } \mathbf{+ EE\ MWh}}$$

$$\frac{(79{,}993{,}008 \times 1{,}999) + (297{,}502 \times 1{,}332) + (27{,}411{,}350 \times 963) + 2{,}791{,}474{,}084}{79{,}993{,}008 + 297{,}502 + 27{,}411{,}350 + 2{,}818{,}194 + 993{,}077 + 13{,}775{,}594 \mathbf{+ 16{,}284{,}584}}$$

Rate – 1,338 lbs/MWh

	EE Avoided Gen.
2012 Sales (scale by 1.0751)	152,456,864 MWh
EE Savings	11.56%
Net Import Adjustment	86%
EE MWh	16,284,584 MWh

Where can I find this data?

Appendix 1 of the Goal Computations TSD http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-technical-documents
and
Chapter 5 of the GHG Abatement Measures TSD describes the derivation of the 11.56% figure. http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-ghg-abatement-measures

Regional Contacts

Region	Name	Email	Phone
1	Shutsu Wong	wong.shutsu@epa.gov	617-918-1078
2	Gavin Lau	lau.gavin@epa.gov	212-637-3708
3	Mike Gordon	gordon.mike@epa.gov	215-814-2039
4	Ken Mitchell	mitchell.ken@epa.gov	404-562-9065
5	Alexis Cain	cain.alexis@epa.gov	312-886-7018
6	Rob Lawrence	lawrence.rob@epa.gov	214-665-6580
7	Ward Burns	burns.ward@epa.gov	913-551-7960
8	Laura Farris	farris.laura@epa.gov	303-312-6388
9	Ray Saracino	saracino.ray@epa.gov	415-972-3361
10	Madonna Narvaez	narvaez.madonna@epa.gov	206-553-2117